

## **Satisfaction-induced travel behaviour**

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## Satisfaction-induced travel behaviour

### Abstract

Numerous studies – mainly since 2010 – have found that the chosen travel mode is related with how satisfied people are with their performed trips. A consensus has been found in that active travel results in the highest levels of satisfaction, while public transport users are usually least satisfied with their trips. However, evidence of why the use of various modes results in different levels of travel satisfaction is currently lacking. In this conceptual paper, I argue that the effect of travel mode on travel satisfaction might be overestimated, and that it is not so much the travel mode itself that affects satisfaction with travel, but whether the chosen travel mode is consistent with attitudes towards that mode. Furthermore, travel satisfaction might affect travel mode choice and travel attitudes more than vice versa. In this paper a new model is proposed reshaping the links between travel satisfaction, travel attitudes and travel mode choice. I underpin the suggested relationships with travel behaviour literature and psychological theories, draw parallels with (transport-related) residential self-selection, and reflect on the difficulties and possibilities of measuring this model. Finally, I focus on the implications of the proposed model on travel behaviour research.

**Keywords:** Travel behaviour; Travel attitudes; Travel satisfaction; Travel mode choice

### 1. Introduction

Partly due to an increased interest in subjective well-being by scholars in multiple disciplines, but also by policy makers and society in general (e.g., Frey, 2018), transport studies have recently started focussing on the link between travel and well-being, and how people perceive their travel (De Vos et al., 2013; Mokhtarian, 2018). Although some older studies analysing travel satisfaction – i.e., experienced emotions during trips and/or evaluation of these trips – exist (e.g., Anable & Gatersleben 2005; Reibstein et al., 1980), the number of studies examining travel satisfaction has rapidly increased since 2010. This can be partly explained by the development of domain-specific scales (such as the Satisfaction with Travel Scale (STS) (Ettema et al., 2011)), standardising the way travel satisfaction is measured. Most travel satisfaction studies have focussed on the determinants of travel satisfaction, especially on the effects of the chosen travel mode. These studies found the highest levels of satisfaction for active travellers, while public transport users are generally least satisfied with their trips (e.g., De Vos et al., 2016; Morris & Guerra, 2015b; St-Louis et al., 2014; Ye & Titheridge, 2017). Besides the chosen travel mode, a considerable number of studies has also looked at the effect of trip duration on travel satisfaction, indicating that longer trip durations often result in low satisfaction levels (e.g., Higgins et al., 2018; Morris & Guerra, 2015a; Zhu & Fan, 2018a). Studies also found that travelling alone results in lower levels of travel satisfaction compared to travelling in companionship (e.g., De Vos, 2017; Lancée et al., 2017; Zhu & Fan, 2018b), that travel distance can have both negative and positive effects on satisfaction with travel, depending on trip purpose (De Vos et al., 2016; Handy & Thigpen, 2018; Mokhtarian et al., 2015; Schneider & Willman, 2019), and that the performance of activities during (public transport) trips can affect travellers' evaluation of the trip made (e.g., Ettema et al., 2012; Lyons et al., 2007; Tan et al., 2018).

Besides trip characteristics, recent studies have also looked at the effect of attitudes on travel satisfaction. De Vos and Witlox (2016) and Ye and Titheridge (2017) found that positive attitudes towards travel in general (i.e., travel-liking attitudes) are positively correlated with travel satisfaction. Three studies also found that a positive attitude towards a certain mode has a positive effect on travel

satisfaction when using that mode (De Vos et al., 2016; St-Louis et al., 2014; Ye & Titheridge, 2017). Earlier studies focussing on public transport also found that positive attitudes towards bus use (Reibstein et al., 1980) and public transport in general (Abou-Zeid & Ben-Akiva, 2012; Abou-Zeid et al., 2012) positively affect satisfaction with bus use and public transport use, respectively. Besides studies analysing the determinants of travel satisfaction, studies looking at how travel satisfaction might (potentially) influence travel-related elements such as attitudes and mode choice are scarce (De Vos & Witlox, 2017).

Although numerous studies indicate that travel satisfaction varies according to the chosen travel mode, this effect might be overestimated and partly mediated by travel attitudes. In this paper I develop a model describing the relationships between travel attitudes, travel mode choice and travel satisfaction. This model indicates that travel satisfaction is mainly affected by the consistency between attitudes and mode choice, and that satisfaction levels in turn can change travel attitudes and future mode choices. This paper is organised as follows. Section 2 describes existing studies focusing on travel satisfaction differences between the use of various travel modes. In Section 3, a new model is presented, which is discussed in Section 4.

## **2. Travel satisfaction and mode choice**

Table 1 provides an overview of papers analysing satisfaction with travel (from emotions experienced during specific trips to overall evaluation of travel) according to the chosen travel mode. A search in Web of Science and in various transportation journals resulted in 29 studies found (final search: February 2019). These studies took place in Europe and North-America, and recently also in China. Most of these studies focus on commute trips, leaving other types of trips (e.g., leisure trips) underexposed. Some studies analysed the most recent trip or trips on the day prior to the measurement of travel satisfaction, while others focussed on a usual (commute) trip or overall satisfaction with (commute) travel. Although these studies took place in different regions (with varying levels of facilities for public transport and active travel), focussed on different types of trips and used various ways of measuring travel satisfaction, all of them (except for Westman et al. 2017, and Zhu & Fan, 2018a)<sup>1</sup> found the highest levels of travel satisfaction for an active travel mode. Most studies indicate that car use results in intermediate levels of travel satisfaction, with car passengers being somewhat more satisfied than car drivers (e.g., Mokhtarian et al., 2015). The use of public transport mostly results in relatively unsatisfied travellers, especially when using the bus. Using subway or train is perceived somewhat more positively, sometimes even more positive than driving. Rather surprisingly, e-cycling seems to be perceived relatively negative in three Chinese studies (Ye & Titheridge, 2017, 2019; Zhu & Fan, 2018a). This contradicts with a Dutch study indicating that e-cyclists are more satisfied with commute trips compared to car users (de Kruijf et al., 2018).

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<sup>1</sup> The studies of Westman et al. (2017) and Zhu and Fan (2018a) found the highest travel satisfaction levels for riders of school buses and employer-provided shuttle buses, respectively. The high levels of travel satisfaction might be partly explained by the fact that travelers know the other passengers, creating opportunities for social interaction. This is in line with studies indicating that travelling in companionship has a positive effect on travel satisfaction (De Vos, 2017; Mokhtarian et al., 2015; Zhu & Fan, 2018b).

Table 1. Studies comparing travel satisfaction levels of respondents using various travel modes (chronologically from old to new; PT = public transport)<sup>2</sup>

Study	Region	Type of trip/travel	Scale used/emotions measured	Mode rank according to travel satisfaction
Anable & Gatersleben (2005)	United Kingdom	A usual commute and leisure trip	Relaxation, No stress, Excitement, Control, Freedom (aggregated)	1) Cycling; 2) Walking; 3) Car; 4) PT
Gatersleben & Uzzell (2007)	United Kingdom	A usual trip to work	Stressful, Exciting, Boring, Relaxing, Pleasant, Interesting, Depressing (aggregated)	1) Cycling; 2) Walking; 3) Car; 4) PT
Duarte et al. (2010)	Respondents from multiple countries	Commute trips	Overall level of satisfaction	1) Cycling; 2) Walking; 3) Metro; 4) Train; 5) Car; 6) Bus
Paez & Whalen (2010)	Canada	Commute trips	Comparison of travel liking between users of different modes	1) Walking/cycling; 2); Car; 3) PT
Ettema et al. (2011); Eriksson et al. (2013)	Sweden	Different types of hypothetical bus and car trips	STS <sup>3</sup>	1) Car; 2) Bus
LaJeunesse & Rodriguez (2012)	United States	A usual trip to work	Stress	1) Walking, 2) Cycling, 3) Bus; 4) Car
Friman et al. (2013); Olsson et al. (2013)	Sweden	Most recent normal commute to and from work	STS	1) Walking/cycling; 2) Car; 3) PT
St-Louis et al. (2014)	Canada	A usual commute trip	Overall level of satisfaction with used modes	1) Walking; 2) Train; 3) cycling; 4) Car; 5) Subway; 6) Bus
De Vos et al. (2015, 2016); De Vos (2018)	Belgium	Most recent leisure trip	STS	1) Walking; 2) Cycling; 3) Car; 4) PT
Legrain et al. (2015)	Canada	Commute trips	Stress	1) Walking; 2) PT; 3) Car
Mokhtarian et al. (2015)	France	A single trip made on the day before measurement	Pleasantness, Tiredness	1) Cycling; 2) Walking; 3) Scooter; 4) PT; 5) Car passenger; 6) car driver

<sup>2</sup> In case studies analysed emotions experienced during trips separately (without aggregating them), the rank of modes is only based on positive emotions (in order to enhance readability). For studies focussing on a negative emotion (e.g., stress), modes associated with the lowest levels are ranked first.

<sup>3</sup> The Satisfaction with Travel Scale (STS) consists of nine items, six referring to emotions experienced during trips and three referring to a cognitive evaluation of the trip(s) made. The six pairs of emotions are derived from specific combinations of valence and activation – i.e., negative deactivation - positive activation (bored - enthusiastic, fed up - engaged and tired - alert) and negative activation - positive deactivation (stressed - calm, worried - confident and hurried – relaxed). The cognitive evaluation of travel is measured by a set of adverse statements regarding the trip made (i.e., travel was the worst - best I can think of, travel was low - high standard and travel did not go well - went well). For more information on the STS, see De Vos et al. (2015); Ettema et al. (2011), and Friman et al. (2013).

Morris & Guerra (2015b)	United States	Travel on the day before measurement	Happiness, Pain, Stress, Sadness, Fatigue (aggregated)	1) Cycling; 2) Car; 3) walking; 4) Bus; 5) Train
Thomas & Walker (2015)	United Kingdom	A usual commute trip	Pleasant, Exciting, Relaxing, Boring, Depressing, Stressful (aggregated)	1) Cycling; 2) Walking; 3) Car; 4) PT
Mao et al. (2016)	China	Commute trips	Overall level of satisfaction	1) Walking; 2) Cycling; 3) Car; 4) Subway; 5) Bus
Lancée et al. (2017)	Netherlands	Commute trips on the day before measurement	Overall level of happiness	1) Walking; 2) Cycling; 3) Car; 4) PT
Smith (2017)	United States	Most recent commute trip to work	(adjusted) STS	1) Cycling; 2) Walking; 3) Express bus; 4) Light rail; 5) Carpool; 6) Local bus; 7) Drive alone
Westman et al. (2017)	Sweden	Children's trip to school on the day of measurement	(adjusted) STS (STS for children: STS-C)	1) School bus; 2) Walking/cycling; 3) Car
Ye & Titheridge (2017, 2019)	China	Most recent commute trip to work	STS	1) Cycling; 2) Walking; 3) Car; 4) Worker bus; 5) Train; 6) Bus; 7) E-cycling
de Kruijf et al. (2018)	Netherlands	Commute trips	STS	1) E-cycling; 2) Car
Handy & Thigpen (2018)	United States	Commute trips	Overall level of satisfaction	1) Walking; 2) Cycling; 3) Train; 4) Car; 5) Bus
Singleton (2018)	United States	Most recent commute trip to work	(adjusted) STS	1) Walking; 2) Cycling; 3) PT; 4) Car
Waygood et al. (2018)	Respondents from Canada, Japan, and Sweden	Children's overall travel	Overall level of satisfaction	1) Cycling; 2) Car; 3) Walking; 4) PT
Zhu & Fan (2018a)	China	Most recent commute trip to work	Overall level of satisfaction	1) Employer-provided shuttle bus; 2) Cycling (private bike); 3) Walking; 4) Subway; 5) E-cycling; 6) Cycling (public bike); 7) Bus
Zhu & Fan (2018b)	United States	Travel on the day before measurement	Happy, Meaningful, Pain, Sad, Tired, Stressed	Happy: 1) Cycling; 2) Car passenger; 3) Car driver; 4) Walking; 5) PT Meaningful: 1) Cycling; 2) Walking; 3) Car driver; 4) Car passenger; 5) PT

Of course, elements affecting travel satisfaction differ according to which travel mode has been chosen (e.g., De Vos & Witlox, 2017; Susilo & Cats, 2014), since certain trip characteristics are tied to the use of specific travel modes. The way people perceive public transport trips is influenced by service attributes such as punctuality, frequency, cleanliness, comfort, and the personnel's behaviour (e.g., de Oña et al., 2013; dell'Olio et al., 2011; van Lierop et al., 2018). Satisfaction with car trips can be affected by elements such as congestion levels, travel time reliability, parking availability, annoyance with other

road users, and experienced traffic safety (Ettema et al., 2013; Morris & Hirsch, 2016; Novaco & Gonzalez, 2009). Satisfaction with walking and cycling can be affected by weather conditions/seasonality, the presence of slopes, personal fitness levels, and the presence and quality of walking/cycling infrastructure (Manaugh & El-Geneidy, 2013; Pucher & Buehler, 2008; Willis et al., 2013). Susilo and Cats (2014) indicate that satisfaction with cycling is most positively correlated with a barrier-free, smooth ride and the absence of hindrances from other transport modes. Alfonzo (2005) and Stradling et al. (2007) state that pedestrians' satisfaction is also affected by the pavement condition, the number and safety of crossings and aesthetic appeal of the surroundings (e.g., presence of trees/flowers).

### **3. Towards a new conceptual model**

#### **3.1 An overestimation of the effect of travel mode on travel satisfaction?**

Although numerous studies have indicated that the chosen travel mode has a significant effect on travel satisfaction, this link might actually be overestimated. There is no clear reason why one mode would result in lower or higher levels of satisfaction compared to other modes. Furthermore, studies on travel satisfaction barely give explanations for these differences; and when they do, these explanations are not empirically founded and therefore not entirely convincing. It might be possible, for instance, that walking and cycling result in high levels of satisfaction because the related physical activity results in the release of dopamine which affects arousal and attention, and can improve mood and reduce anxiety (Paluska & Schwenk, 2000; Penedo & Dahn, 2005). The low levels of satisfaction with public transport trips might possibly be caused by a (perceived) lack of control (Beirão & Cabral, 2007). On the other hand, it might also be possible that certain mode-specific elements have stronger effects on travel satisfaction for one mode compared to another mode. For instance, inferior punctuality of public transport might affect travel satisfaction more negatively than the absence of good cycling facilities, while the physical activity related with active travel might have a stronger positive effect on travel satisfaction compared to the possibility of performing activities during public transport trips. However, no study up till now has been able to indicate why travel satisfaction levels differ according to the chosen travel mode. In this study, the assumption is made that travel satisfaction differences between various modes are not caused by characteristics of the mode itself, but are mediated by travellers' attitudes.

The reason why travel satisfaction varies between different travel modes might be explained by the extent to which people travel with a preferred travel mode. People able to travel with a mode that they like, will most likely experience their trip positively, while people being forced to travel with a non-desired travel mode might not be satisfied. Two studies (De Vos, 2018; Ye & Titheridge, 2019) found that a negative stance towards the used mode, or not using a preferred mode (i.e., a 'mismatch' or 'dissonance' between travel attitudes and chosen mode) has a significant negative effect on travel satisfaction. De Vos (2018), for instance, indicates that – independent of the used travel mode – consonant travellers (those travelling with a preferred mode) have above average travel satisfaction levels, while dissonant travellers (those travelling with a non-preferred mode) have – except for pedestrians – below average travel satisfaction levels. This suggests that using a preferred travel mode has a stronger impact on travel satisfaction than the chosen travel mode itself. Travel satisfaction might consequently be closely related with mode-specific attitudes. The respectively low and high levels of satisfaction of public transport users and people walking/cycling could be linked to the overall negative attitudes towards public transport and positive attitudes towards active travel (Anable & Gatersleben, 2005; De Vos, 2018; Kroesen et al., 2017; van Wee et al., 2002).

A similar train of thoughts can be made concerning the effect of attitudes on travel satisfaction. Travel attitudes themselves might not affect travel satisfaction, but attitudes towards the chosen mode will most likely affect travel satisfaction. In most cases, a positive stance towards a certain mode will positively affect travel satisfaction when using that mode, while the effect of this attitude on travel satisfaction when using other modes is limited (De Vos et al., 2016; St-Louis et al., 2014; Ye & Titheridge, 2017). These results seem to be confirmed by Mokhtarian et al. (2015, p. 1123), stating that “those who liked the mode they used for the trip were more likely to rate the trip as pleasant, and less likely to rate it as unpleasant”. In sum, it can be argued that the chosen travel mode and mode-specific attitudes themselves are not an important element affecting travel satisfaction, but whether or not the chosen travel mode is consistent with mode-specific attitudes. This is in line with the theory of cognitive dissonance (Festinger, 1957), indicating that an inconsistency between attitudes and behaviour will result in psychological discomfort. An inconsistency between the chosen travel mode and mode-specific attitudes can be referred to as travel mode dissonance (De Vos, 2018). Such a dissonance can result from the presence of travel barriers or the absence of travel skills or travel options (e.g., distances being too long for active travel, a person not able to ride a bicycle/drive a car, or the absence of public transport services in a person’s neighbourhood, respectively).

### **3.2 The effect of travel satisfaction on travel attitudes and travel mode choice**

Although not a lot of travel behaviour studies have focussed on it, travel satisfaction can also affect travel-related attitudes.<sup>4</sup> Despite that the theory of planned behaviour (Ajzen, 1991) – often applied in travel behaviour studies – indicates that attitudes are barely subject to change, other (psychological) studies indicate that satisfaction with previous choices can change the attitude towards the attitude object (e.g., Clore & Schnall, 2005; Eagly & Chaiken, 1993). Zajonc (2000) even claims that satisfaction is the dominant force in attitude formation. Satisfaction with a certain choice or activity can influence the attitude towards that choice/activity through processes such as classical conditioning and association (Clore & Schnall, 2005; Eagly & Chaiken, 1993).<sup>5</sup> In terms of travel behaviour, this means that satisfying trips with a certain travel mode might improve the attitude towards that mode, while negatively perceived trips might worsen the stance towards the used mode. De Vos et al. (2018b), for instance, found that satisfying walking and cycling trips positively affect attitudes towards these respective modes. Although it can be expected that attitudes towards a certain mode will only gradually change after a certain number of positively or negatively perceived trips with that mode (especially when a preferred mode is experienced negatively, or vice versa), it remains up till now unclear to what extent and how fast travel satisfaction can influence travel attitudes.

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<sup>4</sup> Although attitudes and satisfaction both relate to a degree of a positive or negative evaluation of a certain choice or behaviour, clear differences exist. Satisfaction – which refers to the experience of emotions (or mood) during a certain activity episode (affective dimension), and the evaluation of that performed activity (cognitive dimension) – is ephemeral and cannot be stored. The evaluative information it carries is temporally constrained and vanishes as soon as a person does not reflect on that activity episode anymore (Clore & Schnall, 2005). Attitudes – which can be defined as a degree of a favourable or unfavourable appraisal of a certain object, person or behaviour (see, for instance: Ajzen, 1991; Eagly & Chaiken, 1993) – are not evaluative states, but evaluative tendencies, that do not automatically disappear when a person stops thinking about the attitude object. Attitudes are consequently not constrained by time and may be either temporary or enduring (Clore & Schnall, 2005; Eagly & Chaiken, 1993). Furthermore, people might have a (positive or negative) attitude towards a certain activity without ever having performed and experienced that activity (e.g., a person with a negative stance towards public transport while having never used public transport). This attitude might have been formed by information regarding the attitude object received from family, friends or media, and not by previous experiences.

<sup>5</sup> Conditioning can be described as a process of changing behavior or attitudes by rewarding or punishing a person each time an action is performed until the person associates the action with pleasure or distress.

Furthermore, satisfaction might not only impact attitudes, but also behaviour. Choices are partly based on how previous choice outcomes have been experienced (e.g., Kahneman et al., 1997). A positively experienced choice increases the chance that a person will choose the same alternative in a future decision process. This link between satisfaction and behaviour has often been analysed in the domain of marketing and consumer behaviour. These studies indicate that customers' satisfaction strengthens customer loyalty, meaning that satisfied customers are likely to continue using that service (e.g., Olsen, 2007). Some studies, focussing on public transport costumers, indicate that satisfaction with public transport services positively affects the intention of continuing to use public transport (e.g., Lai and Chen, 2011). In a relatively old study, Reibstein et al. (1980) indicated that satisfaction with bus trips has a positive effect on bus use frequency. A qualitative study of Beirão and Cabral (2007) indicates that the perceived service performance of car and public transport trips has an important effect on choosing one of these modes. Finally, Abou-Zeid and Ben-Akiva (2012) showed that lower satisfaction with car use and higher satisfaction with public transport use (due to offering habitual car drivers a one-month free public transport pass) make a mode switch from car to public transport more likely. It is also possible that the effect of travel satisfaction on mode choice is indirect, through travel-related attitudes. Since satisfaction might affect attitudes, rewarding trips with a certain travel mode might increase the propensity of using that mode for a future trip owing to an improved stance towards that mode (De Vos et al., 2018b).

The effects of travel satisfaction on attitudes and mode choice are also in line with Festinger's cognitive dissonance theory (1957), stating that people will try to reduce discomfort (or dissatisfaction) by changing either behaviour or attitudes, so attitudes and behaviour will better match. From this point of view, it is likely that travel satisfaction will mainly affect attitudes and future mode choices in case of low travel satisfaction. When people are dissatisfied with trips using a certain mode they will try to use another mode in the future. However, when this is not possible (e.g., a car lover being forced to use public transport because he/she cannot afford a car) people might change their attitudes – by (subconsciously) allocating positive elements to the chosen alternative and negative elements to the non-chosen alternative – in order to justify their made decision.<sup>6</sup> In case of high levels of travel satisfaction, it is possible that a stable situation occurs – comparable to habitual mode choice – in which people will continue using a favoured mode that previously resulted in satisfying trips (De Vos & Witlox, 2017).

### **3.3 A conceptual model outlining the relationships between travel mode choice, travel attitudes and travel satisfaction**

Based on the explanation provided in the previous two sections, a new conceptual model is created (Figure 1). In this model I claim that travel satisfaction is not directly affected by the chosen travel mode and mode-specific attitudes themselves, but by the consistency between these two elements. An inconsistency (or mismatch) between travel attitudes and mode choice (i.e., travel mode dissonance) will most likely result in low levels of travel satisfaction, while travelling with a preferred mode will probably result in high levels of travel satisfaction (De Vos, 2018). Travel satisfaction can in turn affect the attitude towards the chosen travel mode and the chance of using that mode for future trips of the same kind. Although most travel behaviour studies analysed the effect of attitudes on mode choice (partly based on the theory of planned behaviour (Ajzen, 1991)), some studies also found significant effects from mode choice on attitudes (e.g., Golob, 2001; Kroesen et al., 2017) since people might adjust their attitudes in order to be consistent with their performed behaviour. The proposed

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<sup>6</sup> Due to this justification of forced choices, negatively perceived trips might not only worsen the attitude towards the used mode but might also – to a certain extent – improve the attitude towards that mode.



model therefore suggests an interdependent relationship between travel attitudes and mode choice. As a result, travel satisfaction can also affect attitudes and mode choice indirectly, through mode choice and attitudes respectively. For instance, a positively perceived cycling trip can increase future cycling trips because of an improved stance towards cycling, while it can also improve cycling attitudes because of more future cycling trips.

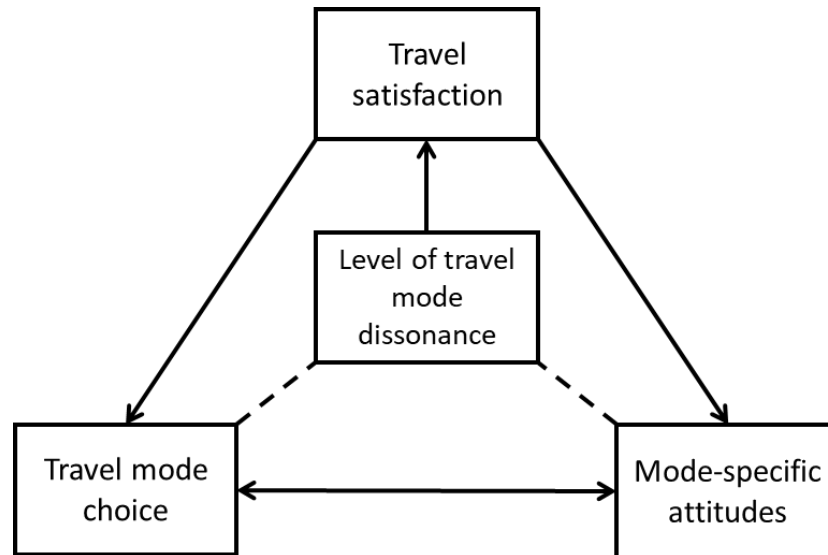


Figure 1. Suggested model outlining the relationships between travel mode (choice), travel attitudes and travel satisfaction.

Parallels from the model outlined in Figure 1 can be drawn to transport-related self-selection, in which people try to choose a residential neighbourhood enabling them to easily travel with their preferred travel mode (e.g., Cao et al., 2009; Handy et al., 2005; Schwanen & Mokhtarian, 2005). These self-selection effects, however, make it difficult to identify the extent to which travel patterns can be attributed to the built environment itself, as opposed to the prior self-selection of residents in a neighbourhood stimulating desired travel patterns. Not taking into account travel attitudes might consequently result in an overestimation of the effect of the built environment on travel behaviour. A similar issue applies for the model shown in Figure 1. Ignoring mode-specific attitudes can result in an overestimation of the effect of travel modes on travel satisfaction. The fact that people try to choose a travel mode they like, makes it difficult to identify the extent to which travel satisfaction is explained by the chosen travel mode itself, as opposed to the self-selection of a preferred travel mode.

Given that variations in travel satisfaction – but also in mode-specific attitudes – exist between different travel modes, suggests that people do not always have a free choice of which travel mode to use. If people had such a choice, they would most likely choose their preferred travel mode and be satisfied with the trip made. However, the overall low levels of attitudes towards – and satisfaction with – public transport suggest that a considerable share of public transport users is forced to travel by public transport, e.g., due to budget constraints (e.g., Beimborn et al., 2003; Jacques et al., 2013). These ‘captive’ public transport users might not enjoy their trips, resulting in relatively negative public transport attitudes. Although the cognitive dissonance theory (Festinger, 1957) suggests that people might allocate positive elements to the chosen alternative in order to justify their made decision (even if it resulted in negative satisfaction levels), it also indicates that a state of dissonance may persist, i.e., in that people are not able to change behaviour, nor find positive aspects supporting their choice (which might have led to improved attitudes). Suggested by intermediate levels of mode-specific

attitudes and satisfaction levels, this captivity might also apply – to a limited extent – to car users, as people living in suburbs and rural areas might not have other travel options than driving (e.g., Mattioli, 2017). High levels of travel satisfaction and positive attitudes towards active travel suggest that pedestrians and cyclists mostly like to walk/cycle (as indicated by De Vos, 2018), indicating limited captivity.

## **4. Discussion**

### **4.1 Limitations and opportunities for measurement**

Although the model described above and shown in Figure 1 is a valid model, I am aware of the difficulties in measuring it. Most studies analysing travel satisfaction focus either on one specific trip (typically the most frequent trip to avoid memory distortion) or on satisfaction with daily travel patterns (e.g., commute trips, leisure trips). The problem with focussing on one trip is that you can only measure the model for people using one specific travel mode in order to measure the effect of travel satisfaction on attitudes towards the chosen mode. However, when doing so the effect of travel satisfaction on travel mode choice can no longer be measured because there is no variation in mode choice.<sup>7</sup> The problem with studies looking at satisfaction with daily travel is that they mostly ask for travel satisfaction independent from the chosen mode. As a result, it is difficult to measure the effect of travel satisfaction on mode-specific attitudes and travel mode frequency, because it is almost impossible to know which travel mode caused that level of travel satisfaction. Of course, it is possible to ask which travel mode respondents usually use to – for instance – travel to and from work. However, doing so results again in limited variation in mode choice, making it difficult to measure the effect of travel satisfaction on mode choice.

Apart from the above-mentioned measurement problems, possible ways to measure the links between mode choice, attitudes and travel satisfaction can be found in the residential self-selection literature. Mokhtarian and Cao (2008) identify different approaches for addressing attitudinal self-selection. Four of these approaches can be selected to analyse the proposed relationships between mode choice, attitudes and travel satisfaction: (1) cross-sectional structural equations models, (2) longitudinal studies, (3) qualitative methods, and (4) statistical control.

Although cross-sectional structural equations models (1) can provide some evidence for the direction of influence, cross-sectional data makes it difficult to measure causality, even when applying structural equation modelling. For instance, a positive effect found from cyclists' travel satisfaction to the choice for cycling, does not necessarily mean that travel satisfaction (of cyclists) positively affects cycling, but it might also mean that cycling results in high levels of travel satisfaction. No robust conclusions on the causal nature of processes can be drawn from cross-sectional data. Furthermore, with cross-sectional data, the (potential) effect of travel satisfaction on mode choice is measured using the chosen mode related to the travel satisfaction measured, while ideally the effect on mode choices of future trips would be measured. This means that true longitudinal data (2) is needed to measure the effects between mode choice, attitudes, and travel satisfaction. Although longitudinal (national) household

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<sup>7</sup> Studies of De Vos et al. (2016), St-Louis et al. (2014), and Ye and Titheridge (2017) – analysing satisfaction of one specific trip – segmented respondents based on their used mode in order to analyse the effect of mode-specific attitudes on travel satisfaction. However, simultaneously measuring the effect of travel satisfaction on mode choice using these data sets would be practically impossible because the variation in mode choice has been removed. This measurement problem has also been acknowledged by De Vos et al. (2018b) when measuring the effects of (i) travel satisfaction on attitudes, and (ii) attitudes on mode choice in a structural equation model.

surveys with large samples and multiple waves exist, questions concerning travel are often limited, mostly leaving out questions regarding travel attitudes and travel satisfaction. A possible solution might be the use of a smartphone application, which can – during a couple of weeks – record satisfaction directly after each trip, accompanied by some questions regarding trip characteristics and attitudes. Examples of these smartphone travel surveys can be found in Sweden (“MyExperience” (Friman et al., 2017)) and in the US (in Minnesota: “SmarTrAC/Daynamica” (Fan et al., 2015; <http://daynamica.umn.edu/>), and in Virginia (Glasgow et al., 2018)).

Qualitative methods (3) – resulting from in-depth interviews or focus groups – can potentially provide useful insights on the causality of effects, sometimes beyond what cross-sectional quantitative data can do. However, the mostly small sample sizes (resulting in limited representativeness) and possible severe biases in case of direct questioning (e.g., memory bias, consistency bias, social desirability) can be regarded as limitations. Finally, statistical control (4) might provide valuable information on the effects of mode choice and attitudes on travel satisfaction. In this method, attitudes towards specific travel modes can be used to classify respondents as consonant or dissonant with respect to the chosen mode. Travel satisfaction of consonant mode users might then be compared to that of dissonant mode users. If, for a certain mode, travel satisfaction of consonants is more similar to that of consonants using other modes, it suggests that attitudes largely explain travel satisfaction. If their travel satisfaction is more similar to dissonant users of that particular mode, it suggests that the chosen travel mode exerts a separate influence that outweighs travel attitudes. By applying this method, De Vos (2018) found that (for car users, public transport users, cyclists and pedestrians) travel satisfaction levels of consonant mode users are similar with consonants using other modes, while mostly significantly higher compared to dissonants using that particular mode. This suggests that the effect of travel mode on travel satisfaction is at least partially mediated by mode-specific attitudes. Using a similar approach – yet without distinguishing between various modes – Ye and Titheridge (2019) found that the variable “mismatch” (i.e., a negative factor score on the attitude towards the used mode) negatively affects travel satisfaction. These two studies – although providing valuable insights into the effects of (the consistency between) mode choice and attitudes on travel satisfaction – do not provide information on possible effects of travel satisfaction on mode choice and attitudes, partly because they use cross-sectional data.

#### **4.2 Implications for travel behaviour research**

The model introduced in this study can shed new lights on the relationships between travel mode choice, travel attitudes and travel satisfaction. So far, most travel behaviour studies have regarded travel satisfaction as an outcome of trip characteristics and travel choices. In our model, travel satisfaction becomes a predictor of travel attitudes and mode choice. In other words, how people experience their trips can affect how people travel. In order for policy makers to stimulate public transport use and active travel, they should consequently invest in measures improving the experience of walking-, cycling- and public transport trips. Based on the existing literature, this could be for instance by: creating separated and barrier-free bike lanes and aesthetically appealing walking environments, and improving public transports’ on-board experience and waiting conditions (see e.g., Susilo & Cats, 2014).

Besides the earlier mentioned parallels with (transport-related) residential self-selection, the model shown in Figure 1 might also be directly related with residential self-selection. Travel satisfaction might be associated with people’s residential location choice, through travel attitudes and travel mode choice. Since travel satisfaction might affect travel attitudes, it is possible that travel satisfaction also

influences the residential location choice. According to the concept of residential self-selection, people partly choose a residential neighbourhood based on their travel needs and preferences (see Cao et al. (2009) for an overview). A car lover will most likely prefer to live in a suburban-style neighbourhood due to good car accessibility, while a bike enthusiast might prefer an urban setting due to short distances and the presence of cycling infrastructure. As a result, satisfaction with car trips – and resulting positive car attitudes – can result in a preference for living in a suburban-style neighbourhood, while satisfaction with walking, cycling and public transport use – and accompanying positive attitudes towards these modes – can result in a preference for living in an urban neighbourhood. In case people actually decide to relocate to a different type of neighbourhood based on changed travel attitudes, it is likely that their travel behaviour and attitudes will further change, stimulated by the new built environment (e.g., De Vos et al., 2018a). As a result, making active travel and public transport more pleasant might also have positive indirect effects on public transport ridership and the share of active travel, through increasing preferences of residing in urban areas.

On the other hand, the residential location can also impact travel satisfaction as travel mode choice (and as a consequence travel mode dissonance) is constrained by the neighbourhood people live in. Independent from travel mode preferences, urban residents might face difficulties travelling by car (due to limited parking opportunities, congestion, low-traffic areas), while suburban residents might not be able to walk or cycle to activities (due to long distances). People who do not live in a desired neighbourhood (based on travel attitudes) might therefore face difficulties in travelling with their preferred travel mode. As a result, they might be forced to use a non-preferred mode, resulting in low levels of travel satisfaction (De Vos et al., 2016).

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